Specifications

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Factors to Consider

- Design – Thickness & Drainage
- Materials – Selection & Proportioning
  - Binder
  - Aggregate
  - Additives
- Traffic
  - Load & Volume

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Factors to Consider

- Environment
  - Precip
  - Temp
  - Elevation
- Construction
  - Plant Production
  - Placement
  - Compaction

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Factors to Consider

	Control	Accommodate
Design	✓	
Traffic		✓
Materials	✓	✓
Environment		✓
Construction	✓	

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Control & Effect

Design

Construction

Materials

Traffic

Environment

Environment

Design

Construction

Materials

Traffic

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Cause & Effect

	Quality			
Design	✓	✓	↓	✓
Traffic				↓
Materials	✓	↓	✓	✓
Environment				
Construction	↓	✓	✓	✓
Performance	☹		☹	

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Spec Possibilities

Mechanical/Physical

Performance
& Strength

Fundamental/Chemical

Mechanisms
& Materials

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Spec Possibilities - *Mechanical*

- *Global ➡ Specific*
  - HMA
    - Performance Characteristics
    - Strength Parameters
    - As-Constructed Properties

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Spec Possibilities - *Mechanical*

Rutting? Cracking? Raveling?

- Global ➡ Specific
  - HMA
    - Performance Characteristics
      - Strength Parameters
        - As-Constructed Properties

Strength? Modulus?

Air Void Content?

Permeability?

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Spec Possibilities - *Fundamental*

- *Specific ➡ Global*
  - Materials & Mechanisms

Spec Possibilities - *Fundamental*

Materials

- Binder Composition
- Aggregate Mineralogy and Morphology
- Additive Characteristics

Mechanisms

- Adhesion
- Cohesion
- Detachment
- Displacement
- Spontaneous Emulsification
- Pore Pressure
- Hydraulic Scour
- pH Instability

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Spec Possibilities – At the Refinery?

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Spec Possibilities – At the Quarry?

Atterberg Limits

Sand Equivalent

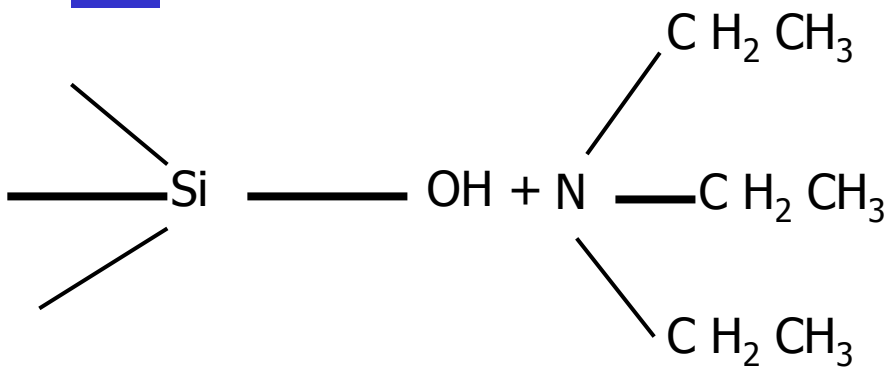
Methylene Blue

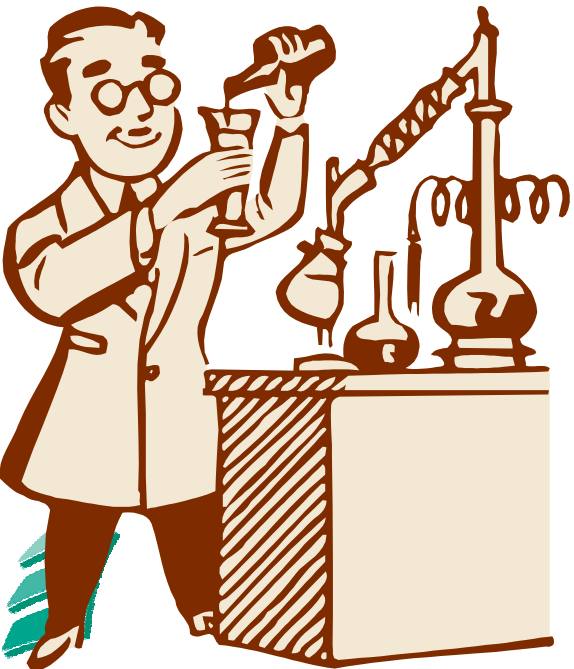
Spec Possibilities – In the Lab?

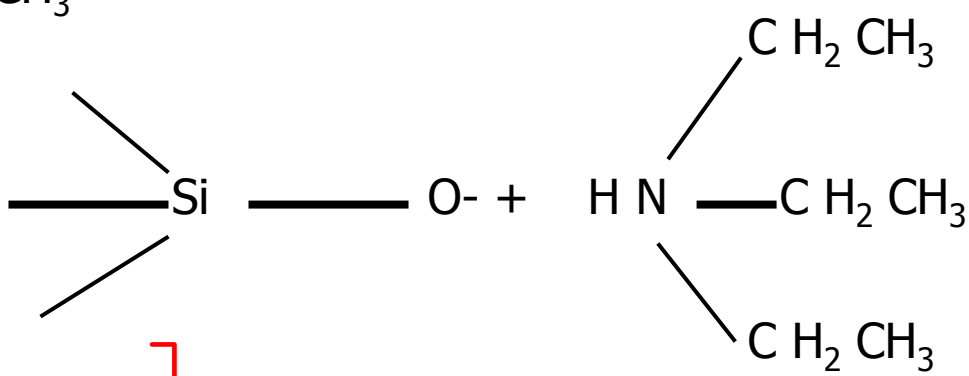
$CaCO_3 + 2RCOOH \rightarrow (RCOO^-)_2 Ca + CO_2 + H_2O$

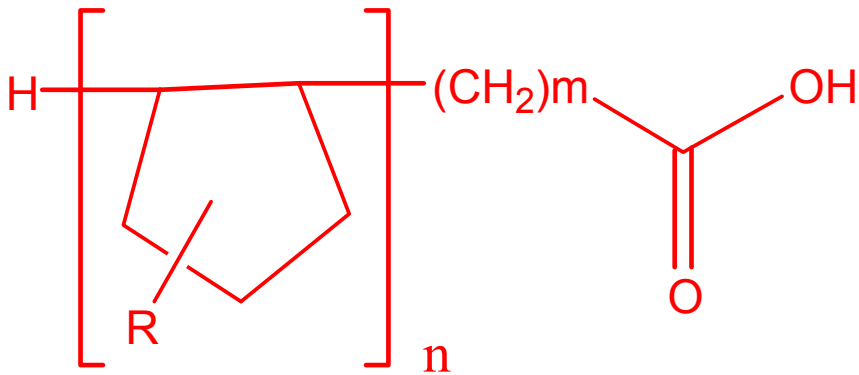
$CaO + 2RCOOH \rightarrow (RCOO^-)_2 Ca + H_2O$

$Ca(OH)_2 + 2RCOOH \rightarrow (RCOO^-)_2 Ca + 2H_2O$









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Spec Possibilities - *Fundamental*

Materials

- Binder Chemistry
- Aggregate Mineralogy
- Additive Characteristics

Mechanisms

- Adhesion
- Cohesion
- Detachment
- Displacement
- Spontaneous Emulsification
- Pore Pressure
- Hydraulic Scour
- pH Instability

Net Adsorption?

Surface Energy?

Zeta Potential?

Electropohoretic Mobility?

SALI?

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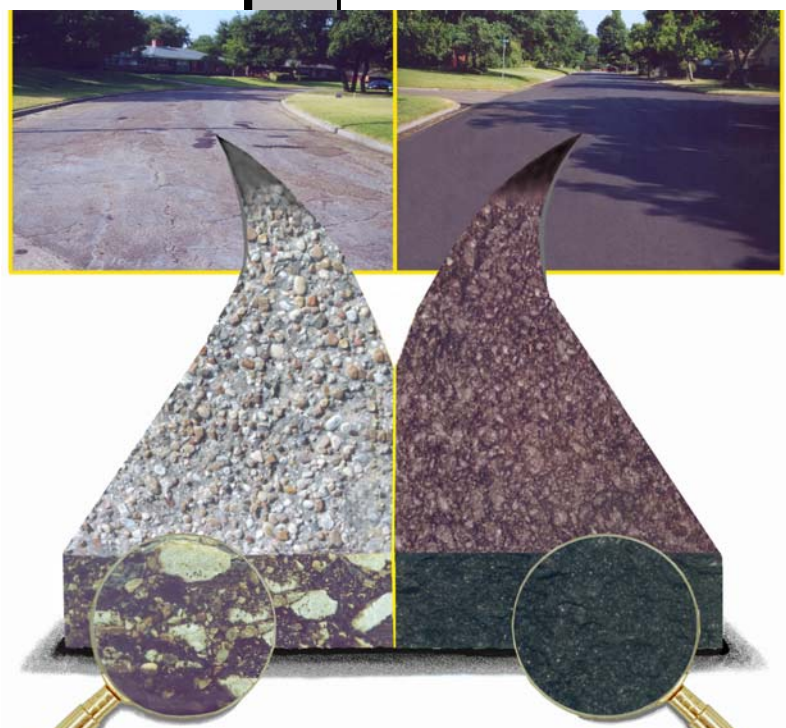
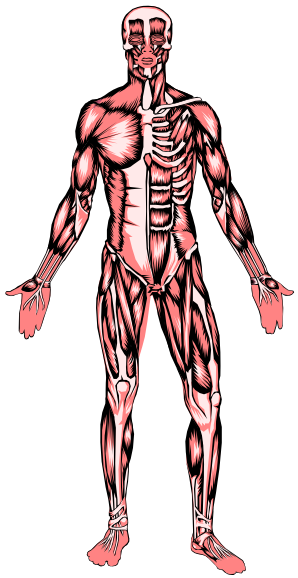
Fundamental/Chemical

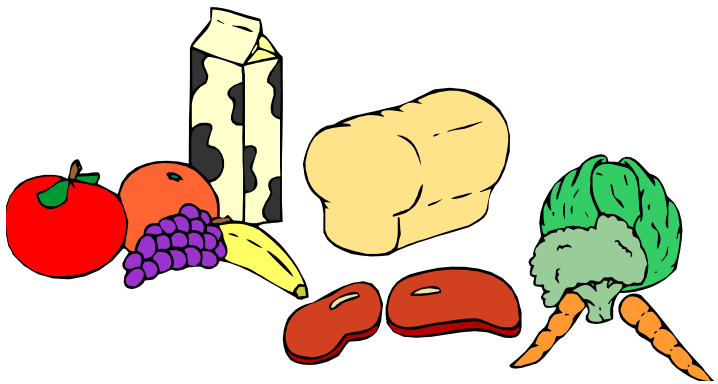
Mechanical/Physical



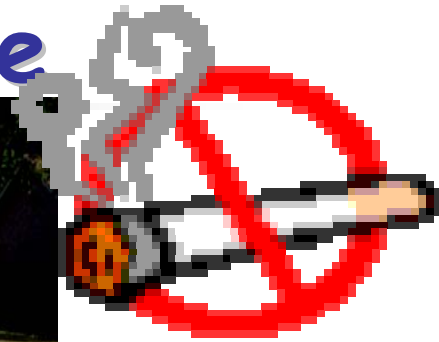
Spec Approach ?

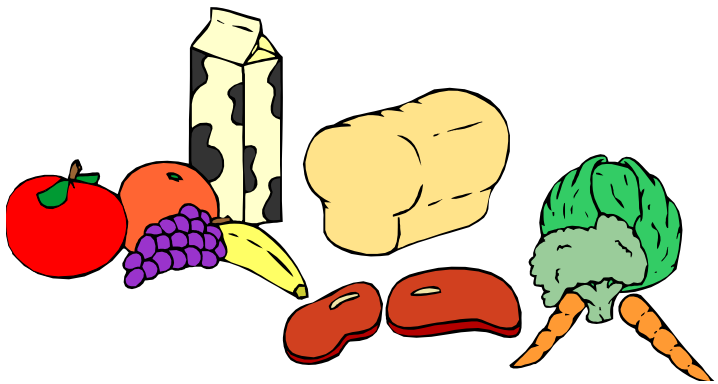
Peak Physical Performance





Peak Pavement Performance



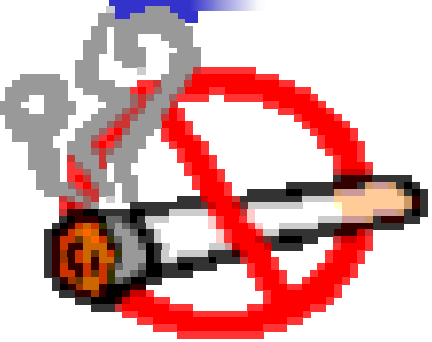


Peak Pavement Performance

Environment

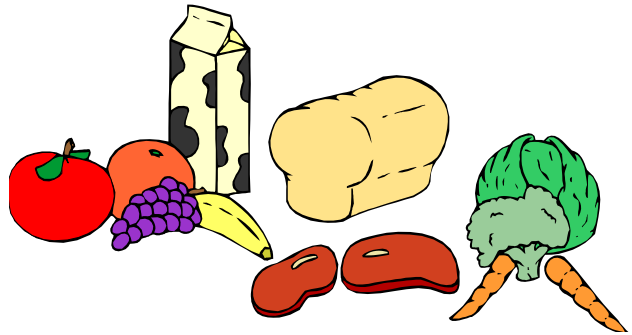
Design

Peak Pavement Performance

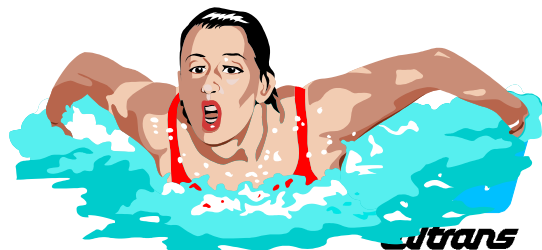


Traffic

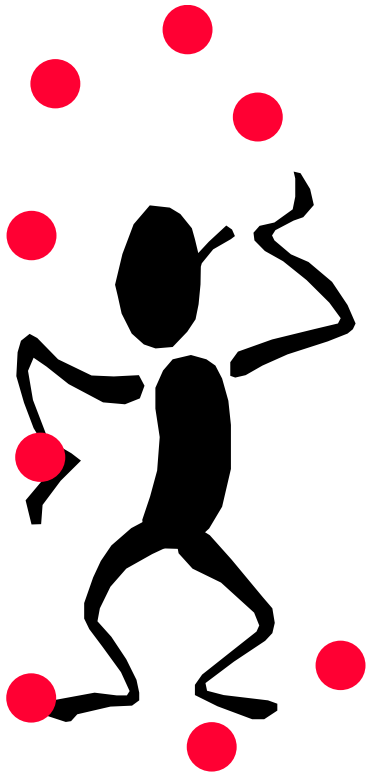
Materials



Construction



Peak Pavement Performance



Spec Approach – Parallel Effort

Implementation

Sound Design

Good Construction Practices

Screening Tools/Tests

Material Quality

Component Compatibility

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Spec Approach

- Implementation – Sound Design
  - Drainage
    - Surface & Subsurface
  - Boundary Conditions
    - Environment & Traffic
  - Materials
    - Selection, Proportioning & Remediation

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Spec Approach

- Implementation –
  - Good Construction Practices
  - Plant Production
    - Moisture Content
  - Hauling & Placement
    - Time & Temp
  - Compaction
    - As-Constructed Air Void Content

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Specifications

- Materials - Screening Tools/Tests
  - Agency Database of Source Properties
    - Material Quality
    - Component Compatibility

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To Spec or Not to Spec

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Questions? Comments?